

The Unit Vector

Now that we understand multiplication and division of a vector by a scalar, we can discuss a very important concept: **the unit vector**.

Lets begin with vector **A**. Say we **divide** this vector by its **magnitude** (a scalar value). We create a new vector, which we will denote as \hat{a}_A :

$$\hat{a}_A = \frac{\mathbf{A}}{|\mathbf{A}|}$$

Q: *How is vector \hat{a}_A related to vector **A** ?*

A: Since we divided **A** by a scalar value, the vector \hat{a}_A has the **same direction** as vector **A**.

But, the **magnitude** of \hat{a}_A is:

$$|\hat{a}_A| = \frac{|\mathbf{A}|}{|\mathbf{A}|} = 1$$

The vector \hat{a}_A has a magnitude equal to **one** ! We call such a vector a **unit vector**.

A unit vector is essentially a **description of direction** only, as its magnitude is always **unit valued** (i.e., equal to one).

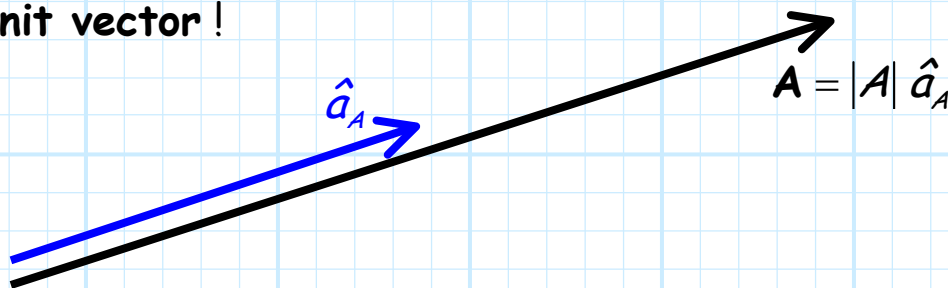
Therefore:

- * $|A|$ is a scalar value that describes the **magnitude** of vector A .
- * \hat{a}_A is a vector that describes the **direction** of A .

Rearranging the formula on the previous page, we can express vector A as:

$$A = |A| \hat{a}_A$$

Thus, **any** vector can be written as the product of its **magnitude** and its **unit vector** !



Q: *What, approximately, is the magnitude of vector A shown above?*

A: $|A| =$